clinical history is not known. Specimen C is an alcoholic preparation of a case of double congenital dislocation in a child of about ten years of age. The right hip is intact, the left hip was operated upon by the old Hoffa method, and the child died of diphtheria one month later. Specimen D is an alcoholic preparation of a right congenital dislocation in a child of four years, who died of scarlet fever without operation. This specimen is the least perfect one, but shows certain features well. Specimen E is an alcoholic preparation of a case of double congenital dislocation in a child of four years. The left hip was operated upon by open incision, and the child died seven months later of whooping-cough. The right hip is as left after forcible reduction.

Before describing the pathological specimens, brief reference is made, for the sake of comparison, to certain features of the anatomy of the normal hip which are of special importance in the deformed joints. The same order is maintained in the description of both normal and pathological specimens, namely: 1. Bones, (*a*) acetabulum, (*b*) femur (head, neck, shaft). 2. Capsule and ligaments. 3. Muscles.

THE NORMAL HIP-JOINT.[1] [2] *Bones.* The acetabulum is a hemispherical cup, directed downward, outward, and forward, bounded by an uneven rim which is thickest above. The centre of the acetabulum, the "fossa acetabuli," is filled with fat tissue which is covered by synovial membrane. The head of the femur is globular, rather more than a hemisphere, directed upward, inward, and forward, with the greater part of its convexity above and in front. Behind and a little below its centre is a depression for the insertion of the ligamentum teres. The *neck* of the femur joins the head to the shaft, and makes, with the shaft, an angle of 130°.[3] [4] Other observers[5] [6] claim that the average angle is some five degrees less. There is considerable individual variation, between 110° and 144°. There is also an inconstant variation with age, sex, and height. But no observer has found the angle of the normal neck with the shaft even to approximate an angle of 90°. The normal shaft shows no appreciable lateral curve, but it is slightly convex forward. The shaft is somewhat rotated on its vertical axis, so that if head and neck are projected upon the same horizontal plane, the long axis of the neck cuts the transverse axis of the condyles at an angle of 25°,[7] giving the so-called "angle of femoral torsion." Other observers make this angle of femoral torsion somewhat greater, but in no case has it been found greater than 37°.[8]

---

[1] Gray's Anatomy, American edition, 1896, p. 278.

[2] Quain's Anatomy, tenth edition.

[3] Gray's Anatomy, loc. cit.

[4] Kraus, cited in Bertaux.

[5] Bertaux. L'Humerus et le Femur, 1891, p. 117.

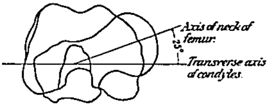
[6] Dwight. The Range and Significance of Variation in the Human Skeleton, 1894.

[7] Bertaux. Loc. cit.

[8] Mikulicz. Ueber individuelle Formdifferenzen am Femur und an der Tibia, p. 350. Arch. Anat. und Entwickelungsgesch, 1898.

Ligaments. The *cotyloid ligament* is a rim of fibrocartilage, which is attached to the margin of the acetabulum, the cavity of which it deepens. It forms practically a complete circle. The *capsular ligament* is attached above to the ilium, just outside the cotyloid ligament, surrounds the neck of the femur, and is inserted in front to the anterior intertrochanteric line, above to the base of the neck, behind to the neck of the bone, 1.2 cm. above the posterior intertrochanteric line. From this attachment fibres are reflected upward over the neck of the femur, " cervical reflection," as far as the articular cartilage of the head. The capsule is thinnest below. The iliofemoral or " Y " ligament is attached above to the lower part of the anterior inferior spine, and descends, diverging, so that the inner portion is inserted into the lower part, the outer portion into the upper part of the anterior intertrochanteric line. The *ligamentum teres* is a triangular ligament, attached to the edges of the cotyloid notch, and inserted into the depression behind and below the centre of the head of the femur.

FIG. 1.



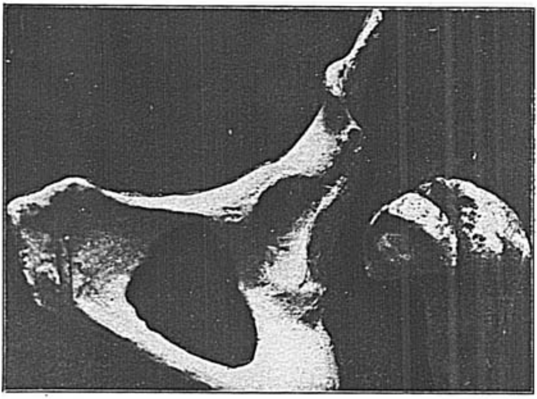
Modified from Bertaux. Shows the normal angle of femoral torsion, 25°.

Pathological Anatomy.

Specimen A is a dry preparation consisting of the greater part of the left innominate bone, of adult size, and includes the acetabulum and the upper fourth of the corresponding femur.

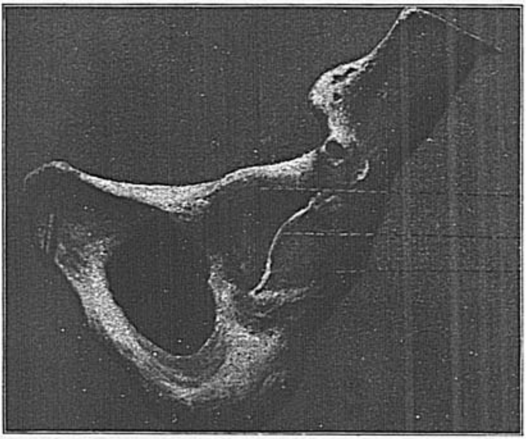
Acetabulum. The acetabulum is small, approximately triangular, with its base just above the obturator foramen, while the apex is directed upward, and slightly outward and backward when the pelvis is held in normal position. The surface of the acetabulum faces almost directly outward. The apex of the acetabulum is just below and slightly anterior to the anterior inferior spine. The base is 2.5 cm. wide at the widest point, and the cotyloid notch is 2 cm. wide. The greatest height of the acetabulum is 4.4 cm. The fossa acetabuli is relatively very large, and its base is fairly smooth and perforated by a few large foramina for vessels. There is evidence of but little normal articular cartilage, and this little extends along the sides of the upper portion of the acetabulum, and is most obvious at the apex. This articular surface is not over 0.5 cm. wide at the widest point. Just posterior to the posterior side of this distorted acetabulum, upon the surface of the ilium, is a smooth triangular surface, with its base toward the acetabulum, and its apex directed backward to a point about 0 4 cm. above the spine of the ischium. This smooth surface appears to represent the surface with which the dislocated head of the femur articulated. It appears as

FIG. 2.



Specimen A. Acetabulum and head of femur. Shows triangular acetabulum, with shallow cavity and overhanging posterior lip. Posterior articular facet. Triangular head, with wheel-like articular rim. Apex of great trochanter above head of femur.

FIG. 3.

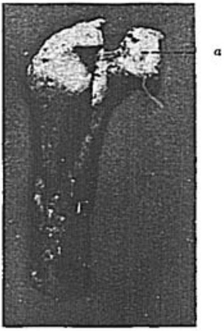


Specimen A. Face of acetabulum. Acetabulum triangular, faces outward, shallow. Slight overhanging of upper lip. Marked convexity and overhanging of posterior lip. Triangular articular facet behind acetabulum.

if the femur had pressed the posterior lip of the acetabulum in such a way that the lip is convex forward, and projects slightly over the base of the cavity. The acetabulum is shallow, only 1.8 cm. deep at the deepest point. The bony base of the acetabulum is thin, approximately 1 cm. Just above the apex of the acetabulum, behind and below the anterior inferior spine, is a prominence apparently for the attachment of the reflected head of the rectus muscle.

Femur. The *head* is flattened laterally, is convex above, and nearly straight below, so that it is converted into a semicircular disk, which lies nearly at right angles to the long axis of the neck. The superior convex surface of the disk is about 1 cm. wide, smooth, and apparently was covered with cartilage during life. It makes a semicircular, half-wheel-like rim, which apparently articulated with the triangular surface on the ilium already described. The lateral surfaces of this disk-shaped head are roughened, and show no evidence of articular cartilage.

FIG. 4.



Specimen A. Left femur seen from behind. Disk-shaped head, with wheel-like articular rim. Top of trochanter higher than head (*a*). Neck joins shaft at an angle of 95°.

The neck is very short, flattened vertically, and widened antero-posteriorly. It joins the shaft at an angle of 95°.

The "angle of torsion" is obviously increased, although since the condyles are lacking the amount of torsion cannot be measured accurately. An attempt was made to measure the angle approximately.

The average angle in twenty normal femurs[1] was found to be 89°, the angle of this specimen (A) was 155°, showing an increase of 66° in the angle of torsion.

---

[1] The linea aspera practically bisects the posterior surface of the femur. The angle made by the long axis of the neck of the femur with a plane passed from the middle of the anterior surface of the shaft of the femur to the linea aspera can be measured. The average angle made in this way was measured in twenty normal femurs taken at random from the collection in the Warren Museum. The average angle in these twenty cases was 89°, the smallest angle was 84°, the largest was 100°. The method is not as exact as the method usually used, but the results are approximate.

Ligaments and *muscles* are wanting in this specimen.

Specimen B is a specimen of double congenital dislocation of the hip in a female adult. The clinical history is unknown, as the specimen was obtained from the dissecting-room. The entire pelvis and rather more than the upper half of each femur have been preserved. Each hip is described separately.

RIGHT HIP. *Acetabulum.* The acetabulum is directed almost directly outward, with slight overhanging of upper lip, is triangular in shape, and has the base directed toward the obturator foramen. The apex of the triangle points upward and slightly outward and backward when the pelvis is in normal position. The apex of the triangle is about 0.8 cm. below and slightly posterior to the base of the anterior inferior spine of the ilium. The greatest width of the base is 2.8 cm., while the width of the cotyloid notch is 1.8 cm. The height of the acetabulum is 4.2 cm. The acetabulum is shallow, 1.2 cm. at the deepest point. The fossa acetabuli is relatively large, and occupies nearly the entire area of the acetabulum, and has a rough base perforated by numerous foramina for bloodvessels. The cartilaginous rim is very small, and appears only as a smooth, narrow rim along the entire posterior side of the triangle, extending over the apex and along the upper half of the upper side. The thickness of the bony base of the acetabulum is approximately 1 cm.

FIG. 5.

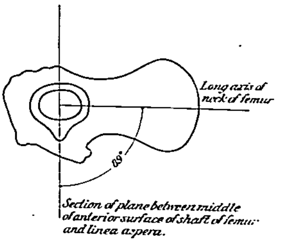

Long axis of neck of femur
89°
Section of plane between middle of anterior surface of shaft of femur and linea aspera.

FIG. 6.

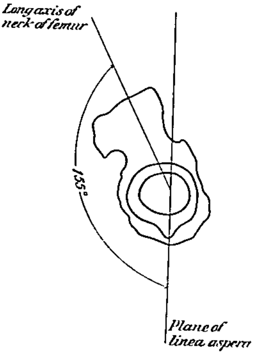


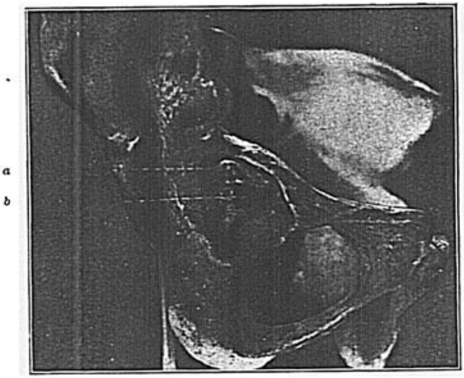
FIG. 5.—Plane middle of anterior surface of shaft of femur and linea aspera, and long axis of neck of femur are projected upon one surface. Angle is 89°.

FIG. 6.—Specimen A. Shows that angle between the plane of the linea aspera and the axis of the neck of the femur is 155°, an increase of 66° in the angle of femoral torsion.

Just above the posterior margin of the acetabulum the surface of the ilium is elevated into a roughened bony ridge, and above this ridge is a pear-shaped depression, probably for the attachment of the reflected head of the rectus muscle. There is no sign of any abnormal articular area upon the surface of the ilium.

Femur. The *head* of the femur is very irregular in shape, rather conical, convex above, flattened below and widened antero-posteriorly, so that the outline of the surface is somewhat irregular. Somewhat below the tip of this triangular head is an ovoid depression, as if for the insertion of a ligamentum teres. Below this depression the surface of the head is roughened, and apparently was not covered with cartilage during life. The head is slightly below the level of the top of the great trochanter.

FIG. 7.



Specimen B. Right acetabulum. Shows triangular, shallow acetabulum (*a*), large fossa acetabuli (*b*), and narrow cartilaginous rim.

The *neck* of the femur is short, triangular on cross-section, and makes an angle of 95° with the shaft. The long angle of the neck makes an angle of 118° with a plane passed between the middle of the anterior surface of the shaft of the femur and the linea aspera. This is 29° greater than the corresponding angle in the twenty normal femurs, and shows that the angle of torsion is 29° greater in this specimen than in the normal femur.

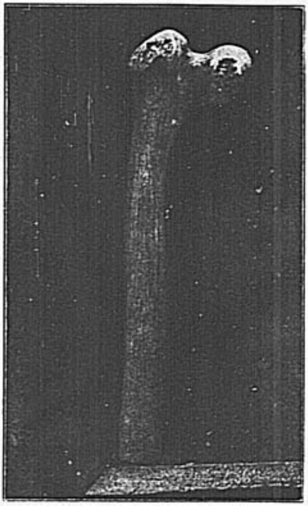
The *shaft*, beginning about 2.5 cm. below the tip of the great trochanter, shows a marked lateral curve, convex outward, extending over a length of 7 cm. Below that point the shaft extends directly downward.

Ligaments and *muscles* are wanting.

Left hip. The left hip presents the same general features, but differs somewhat in details.

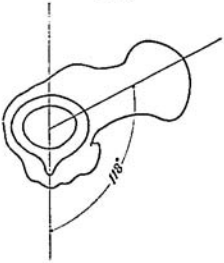
Acetabulum. The acetabulum is triangular, and occupies the same relative position as the right acetabulum. It is 3 cm. wide at the base, while the height is 4 cm. The fossa acetabuli occupies the greater portion of the area. The location of the cartilaginous rim is approximately

FIG. 8.



Specimen B. Right femur, front. Irregular head, lower than the great trochanter, short neck, which joins shaft at an angle of 95°.

FIG. 9.



Specimen B. Right femur. Angle of femoral torsion is 115°.

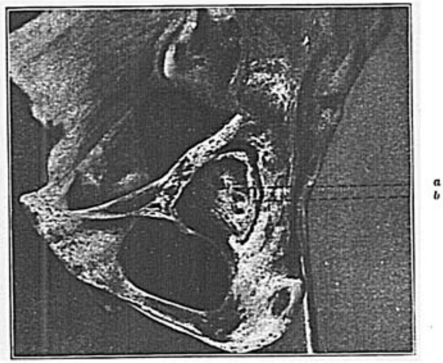
the same as the right acetabulum. The thickness of the bony base of the acetabulum is 1 cm.

Femur. The *head* of the femur shows the same general appearance as that of the right femur, but the depression for the insertion of the ligamentum teres is more marked and is surmounted by a well-marked tubercle. The surface of the head below this depression is smooth, and apparently was cartilaginous articular surface. The highest point of the head is 1 cm. below the top of the great trochanter.

The *neck* is very short, and makes an angle of almost exactly 90° with the shaft.

The shaft shows an outward bowing, corresponding in position and amount with that of the right shaft. The angle of torsion is 31° greater than in the normal hip.

FIG. 10.



Specimen B. Left acetabulum. Acetabulum triangular (*a*), facing almost directly outward. Narrow cartilaginous rim (*b*).

Ligaments and *muscles* are wanting.

Specimen C is an alcoholic preparation of a case of double congenital dislocation of the hip from a child ten and a half years old. The left hip had been operated upon by the old Hoffa method, and the child died during an epidemic of diphtheria one month later. This operation disturbed the relation of the soft parts, and they were still further changed by a partial dissection before the specimen was presented to the museum. The right hip was intact. Each hip is described separately.

Right Hip. The head of the femur is dislocated directly upward and very slightly forward, and rests entirely above the acetabulum upon the external surface of the ilium. In spite of this abnormal position of the head of the bone, the lower end of the femur looks directly forward, as in a normal knee. This is due to the fact that there has been an increase in the amount of femoral torsion, as will be shown later. The joint capsule is opened above by an incision in the long axis of the neck of the femur. The entire femur is sawed open vertically in a plane with the long axis of the neck of the bone.

Acetabulum. The acetabulum is approximately triangular. It faces outward and slightly downward and shows a moderate overhanging of the lip. Its base is just above and directed toward the obturator foramen. Its apex is directed nearly vertically upward when the pelvis is held in normal position, and terminates just below and behind the anterior inferior spine of the ilium. The exact measurements cannot be obtained without sacrificing important structures that it is desired to keep. The cavity looks almost directly outward, and is much shallower than normal, but there is a moderate overhanging of the upper lip.

FIG. 11.

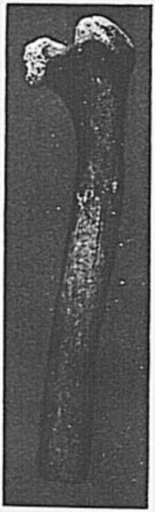


FIG. 12.

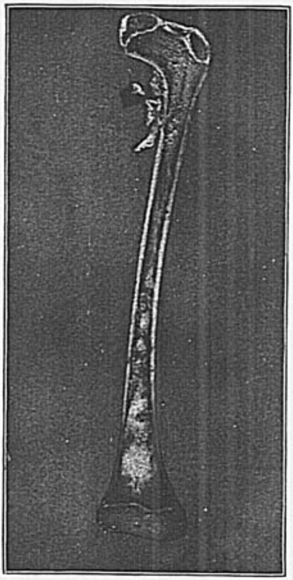


FIG. 11.—Specimen B. Left femur, front. Irregular head, short neck, joining shaft at angle of 90°. Top of great trochanter above level of head.

FIG. 12.—Specimen C. Right femur, anterior half, vertical section, seen from behind. Small head, slightly shortened neck. Neck joins shaft at an angle of 105°.

The fossa acetabuli is larger than normal, and is covered by a thin layer of synovial membrane, which shows numerous small papillary growths.

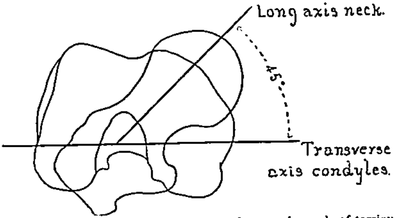
Femur. The *head* is abnormally small, represents approximately two-thirds of a hemisphere, is smooth and covered with cartilage. It presents no depression for the insertion of the ligamentum teres, but instead the cartilage is thickened at that point.

The *neck* appears to be of little less than normal length. It is much thickened vertically, and joins the shaft at an angle of 105°.

The *shaft* shows no lateral curve, but is slightly convex forward. The angle of torsion is greater than in a normal femur. Projected upon a vertical plane the long axis of the neck of the femur cuts the transverse axis of the condyles at an angle of 45°.

Ligaments. The *capsular ligament* presents extreme peculiarities. Below it is attached to the rim of the acetabulum. Laterally it is attached about 0.5 cm. outside the cartilaginous portion of the acetabulum, and consequently the attachment of the capsular ligament is over a narrower area near the apex of the acetabulum. Just above the apex of the acetabulum the capsular ligament is thickened into a rounded ridge of dense fibrous tissue, lined by synovial membrane. This ridge forms a firm retaining wall below the cavity in which the dislocated head of the femur lies, and offers an obvious obstacle to reduction of the head of the femur into the original acetabulum. Above this thickened ridge for a distance of from 2.5 to 3 cm. the capsular ligament is closely adherent to the external surface of the ilium. From the upper limit of this attachment the capsule is reflected outward, beneath the gluteal muscles, and invests the head and a portion of the neck of the dislocated femur. There are numerous adhesions between the inner surface of this reflected capsule and the cartilaginous head. The attachment of the capsule to the femur also is peculiar. The fibres attached to the lower portion of the acetabulum extend to the lower portion of the neck, the fibres attached to the sides of the triangular acetabulum extend to the sides of the neck, while the fibres of the reflected investing capsule extend to the upper surface of the neck.

FIG. 13.



Specimen C. Right hip. Diagram illustrates increase in angle of torsion, 45°.

As a result the capsule as a whole presents the following peculiarities: About the acetabulum the capsular ligament forms a dilated pouch enclosing the dislocated head and neck of the femur. About the original acetabulum it forms a smaller pouch. Between these two pouches

FIG. 14.

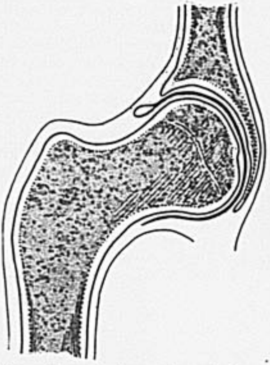
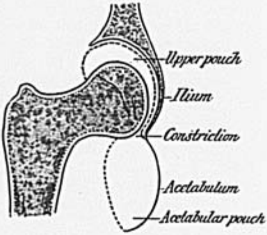


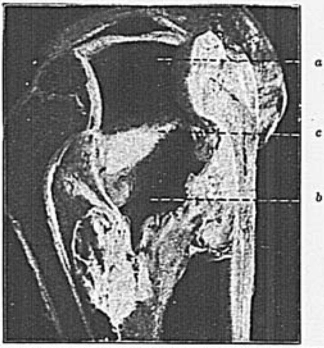
Diagram shows attachment of capsule in normal hip-joint. (After GRAY.)

FIG. 15.



Specimen C. Diagram shows hour-glass attachment of capsule.[1]

FIG. 16.



Specimen C. Right hip. Capsule. Femur is sawn open vertically, and halves are separated. Above is pouch which contained dislocated head (a); below is cavity of original acetabulum (b). Between the two pouches is thickened rim and constricted neck (c).

is a constriction, due to the convergence of the capsular fibres to the sides of the neck of the femur and to the thickening of the capsular ligament into a ridge just above the apex of the acetabulum. Roughly speaking, the capsule may be described as shaped like an hour-glass, or like an old-fashioned silk purse. The upper pouch is adherent to the surface of the ilium internally and to the gluteal muscles externally; the lower pouch surrounds the original acetabulum. The constriction is too small to admit of the passage of the head of the femur.

---

[1] The apparent cavity above the acetabulum is an error in the drawing and did not exist. The same is true of Figs. 18 and 19.

The capsule everywhere seems thicker than normal, and is especially thick where it is attached to the ilium.

Muscles. As far as can be judged without a dissection that would destroy the specimen, the muscles present no obvious abnormality. It appears that muscles offer but moderate resistance to reduction of the deformity. Attempts to reduce the head of the femur in this specimen brings tension upon the capsular ligament, and but little upon the hip muscles, except upon the adductors.

Left hip. The operation upon the joint materially disturbed the relations of capsule and soft parts, and the extensive dissection of the specimen before it was presented to the museum allows only certain features to be studied.

Acetabulum. The acetabulum is triangular, and occupies the same relative position as the right acetabulum—*i. e.*, its base is just above and directed toward the posterior margin of the obturator foramen, while its apex is directed upward and slightly backward and outward, and terminates just below and posterior to the anterior inferior spine of the ilium. The acetabulum faces almost directly outward, with moderate overhanging of the upper lip. The width of the base is 3.75 cm., the height of the acetabulum is 4.4 cm. The width of the cotyloid notch is 2.5 cm. The fossa acetabuli is relatively large, and is filled by a mass of fat, covered with synovial membrane, which in places is covered with papillary growths. The sides and apex of the acetabulum are covered with a layer of cartilage about 1 cm. in width. The acetabulum is shallow, only 1.4 cm. at the deepest point.

Femur. The *head* is small and rather conical. Below its centre is an ovoid depression, as if for the insertion of a ligamentum teres. The upper two-thirds of the head are covered with rather roughened cartilage, while below the depression it is denuded of cartilage and very rough. It is impossible to say whether this roughness is natural or is an artefact.

The *neck* is slightly short, but is thickened vertically. It joins the shaft at an angle of 105°. There is no outward bowing of the shaft, but there is slight convexity forward. There is a marked increase in the angle of torsion. The long axis of the neck intersects the transverse axis of the condyles at an angle of 45°.

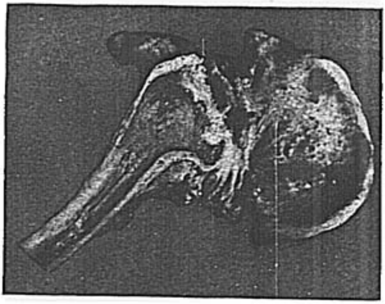
Ligaments. The *capsule* is largely destroyed, but sufficient remains to see that it was attached to the external surface of the ilium for a distance of 4 or 5 cm. above the acetabulum. From the upper margin of that attachment it was reflected outward to invest the head and neck. The attachment to the femur is so extensively divided that only a firm fibrous band ("Y" ligament?) is left, extending from the anterior inferior spine of the ilium downward to be attached to the anterior intertrochanteric line. The ligament is so short that when the head of the femur is placed in the acetabulum the femur is flexed at an angle of 45°, and when the femur is extended the ligament tends to reproduce the dislocation. The remnants of the capsular ligament everywhere are thickened.

Muscles. The muscles have been destroyed so extensively that their arrangement cannot be studied.

Specimen D is an alcoholic preparation of a case of congenital dislocation of the right hip from a child aged four years, who died of scarlet fever without operation. The specimen includes the right innominate bone and 10 cm. of the upper end of the femur. The specimen was somewhat mutilated during removal, and is the least satisfactory of the specimens. The head of the femur is dislocated upward and forward, and rests upon the external surface of the ilium, with the femur rotated outward.

Acetabulum. The acetabulum is approximately triangular, with the base of the triangle just above and directed toward the obturator foramen. The apex of the acetabulum extends upward to just below and behind the anterior inferior spine of the ilium. Exact measurements cannot be obtained without destroying certain features it is desirable to retain. The cartilaginous rim of the acetabulum is exceedingly narrow. The fossa acetabuli is relatively large, roughened, and filled with a mass of dense fibrous tissue. The acetabulum is very shallow and looks almost directly outward.

FIG. 17.



Specimen D. Shows external surface of iliac bone and vertical section of femur. Head is dislocated upward and forward, and lies on external surface of ilium. Head is very small, and is lower than top of great trochanter. The neck joins the shaft at an angle of 100°.

Femur. The *head* of the femur is exceedingly small, very irregular in shape, but covered with cartilage. Below the apex of the head is a slight depression, apparently for the insertion of a round ligament.

The *neck* of the femur is exceedingly short, is contracted vertically, but widened laterally. The neck joins the shaft at an angle of 100°. The angle of torsion is very much increased.

The *shaft* is small and flattened laterally, but shows no lateral curve.

Ligaments. The capsular ligament everywhere is exceedingly thick. The acetabulum is filled with a mass of compact fibrous tissue, which extends in dense bands to the lower portion of the neck. These bands are so short as absolutely to preclude forcible correction of the dislocation. Above the acetabulum the capsule is attached to the upper rim of the acetabulum, and, for a distance of 2 to 3 cm., to the external surface of the ilium. From the upper margin of this attachment the fibres are reflected outward, beneath the gluteal muscles, and invest the head and neck of the femur. All the fibres of the capsular ligament are inserted into the neck near the edge of the articular cartilage. In places the capsule is bound to the cartilaginous head by dense fibrous adhesions. As a whole, the capsular ligament presents the following peculiarities. Above the acetabulum the capsule is dilated and forms a pouch which encloses the head and neck of the femur. This pouch is attached to the external surface of the ilium for a considerable distance, 2 to 3 cm. above the acetabulum. The acetabular portion of the capsule is obliterated by the attachment of the fibres of the capsule to the base of the fossa acetabuli. Between the head of the femur and the external surface of the ilium the capsule is extremely thick and forms a cushion upon which the head rests, with no sign of any articular depression upon the ilium. The thickness of the capsule, the firm adhesions, and the very short fibres seem to make any attempt at forcible reduction impossible.

FIG. 18.

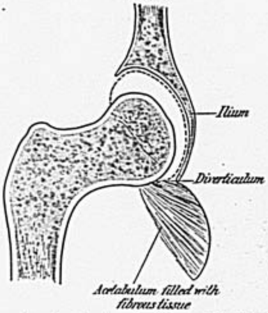


FIG. 19.

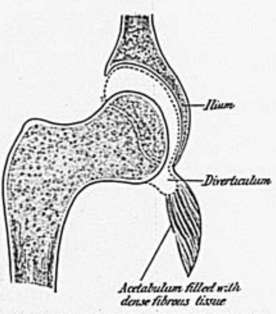


FIG. 18.—Specimen D. Diagram illustrates line of capsule. Acetabulum is filled with dense fibrous tissue. Pouch for head of acetabulum is very small.

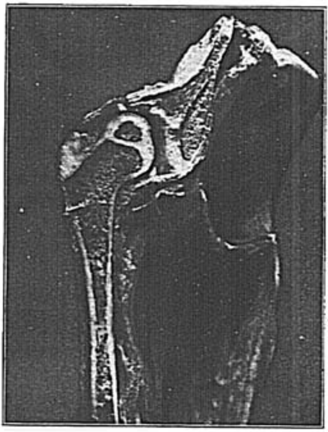
FIG. 19.—Specimen E. Diagram to illustrate shape of capsule. Acetabulum is filled with dense fibrous tissue except at apex, where there is a small diverticulum from main pouch.

Specimen E is an alcoholic preparation of a case of double congenital dislocation of the hip of a child four years of age. The left hip was corrected forcibly, and the deformity was reduced, but recurred two months later. The same hip was then operated upon by the open method, and, as the specimen shows, the deformity was corrected. The child died seven months later of whooping-cough. The right hip was untouched. Each hip is described separately.

Right Hip. The head of the femur is dislocated upward and forward, so that the head lies upon the external surface of the ilium, just above and slightly posterior to the apex of the acetabulum.

Acetabulum. The acetabulum is approximately triangular in shape with a considerable overhang of the upper lip, but is more oval than any of the preceding specimens. The base of the acetabulum is directed toward the obturator foramen, the apex is just below and posterior to the anterior inferior spine of the ilium. The fossa acetabuli is relatively large, although less so than in any of the preceding specimens. The rim of the articular cartilage is correspondingly small. The fossa acetabuli is filled with a mass of dense fibrous tissue, except at the apex, where it is filled with fat, covered with synovial membrane.

FIG. 20.



Specimen E. Right hip. Shows small head, short neck, which joins shaft at angle of 110°. Main pouch and diverticulum can be seen.

The acetabulum as a whole is shallow, about 1 cm. deep at the deepest point, but instead of facing almost directly outward, as the other acetabula do, it faces slightly downward, and offers a better cavity to receive the head of the femur than do any of the other specimens.

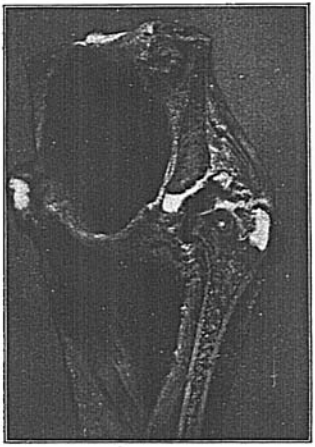
Femur. The *head* is relatively small, more conical than spherical, and entirely covered with cartilage. Just below the apex of the head is an oval depression, apparently for the attachment of a ligamentum teres.

The *neck* is short, and much thickened vertically. It joins the shaft at an angle of 110°. The apex of the head is but very little above the top of the great trochanter.

The *shaft* shows no lateral curve. The angle of rotation is much increased. Projected upon a horizontal plane the long axis of the neck intersects the transverse axis of the condyles at an angle of 50°.

Ligaments. As in the preceding specimens, the *capsule* presents the greatest irregularities. In this specimen the capsule externally is inserted into the neck of the femur, just outside the margin of the articular cartilage. From this line of insertion the capsule invests the head in a closed sac. One side of the sac is attached to the external surface of the ilium for a distance of about 2 cm. above the apex of the acetabulum. The outer surface of the sac is beneath and adherent to the deep surface of the gluteal muscles. In this specimen the capsule shows but little of the hour-glass shape, but is rather a spherical bag, closely investing the head of the femur, with a small diverticulum extending into the apex of the acetabulum. The iliac layer of the sac is extremely thick, and forms a dense cushion upon which the head of the femur rests. There is no evidence of an articular surface upon the ilium.

FIG. 21.



Specimen E. Left hip. Shows head of femur lying in acetabulum. Neck joins shaft at an angle of 115°.

There is no true *ligamentum teres*, but there is a thin, ribbon-like band of fibrous tissue, which extends from the depression in the head of the femur already mentioned to the front of the internal surface of the capsule.

There is no evidence of a *cotyloid* ligament about the cartilaginous rim of the acetabulum.

Muscles. The adductor muscles only offer marked resistance to the reduction of the deformity.

Left hip. As already stated, the left hip was corrected forcibly, and the deformity recurred. Later the deformity was corrected by an open incision. Consequently nothing can be said as to the nature of the dislocation or the relations of the soft tissues. At autopsy the head of the femur was found lying in the original acetabulum, which is sufficiently large to hold and retain it. Although the head of the femur is in the acetabulum, the plane of the condyles of the femur, instead of facing directly forward, is rotated on a vertical axis, so that the internal condyle is further back, the external further forward than normal, and the knee as a whole faces inward.

Acetabulum. The acetabulum cannot be thoroughly examined without destroying certain features that it is desired to preserve. As a whole, its relative position corresponds to that of the left hip.

Femur. The *head* is more nearly spherical than the right and is covered with cartilage. There is a slight depression in the apex of the head as if for the insertion of a ligamentum teres. The head is but slightly above the top of the great trochanter.

The *neck* is relatively somewhat short, and is much thickened vertically. The neck joins the shaft of the femur at an angle of 115°.

The *shaft* presents no lateral curve. The angle of femoral torsion is increased to 43°.

Capsule and *ligaments* have been destroyed, so that no statement regarding them is possible.

CONCLUSIONS. From the examination of these specimens of congenital dislocation of the hip it appears that:

1. As a whole, the anatomical conditions vary within considerable limits in individual cases.
2. Certain anatomical conditions, particularly the peculiarities of the bones, are tolerably constant.
3. The acetabulum is triangular, with its apex directed upward, shallow, faces more or less directly outward, and often is insufficient to retain the head of the femur in place, even if reduction is accomplished.
4. A new articular surface to receive the dislocated head of the femur sometimes is present upon the surface of the ilium.
5. The head of the femur is small, its articular area is diminished and irregular in shape.
6. The neck of the femur generally is short, and makes with the shaft an angle approximating a right angle.
7. The angle of femoral torsion is very much increased by adaptive rotations of the femur upon its vertical axis, so that the knee is brought directly forward. Hence, if reduction is accomplished the knees will tend to face inward, and a secondary osteotomy may be required.
8. Sometimes the shaft of the humerus has an outward convexity in the upper third.
9. The capsular ligament always is irregular, but the irregularity is variable. The capsule may be hour-glass shaped. Then the upper

dilatation is attached to the external surface of the ilium, and encloses the dislocated head of the femur, and is covered by the gluteal muscles. The lower dilatation encloses the original acetabulum. Between the two dilatations is a constricted neck, which may be too small to permit reduction of the head. Or the capsule may not be attached to the rim of the acetabulum, but may form a small globular sac about the head of the femur, attached to the external surface of the ilium. Or from such a globular sac a diverticulum, lined with synovial membrane, may extend into the apex of the acetabulum. The capsular ligament may be too short to allow the head to remain in the acetabulum, even if reduction is possible.

10. The ligamentum teres is absent in the cases examined.

11. The cotyloid ligament is small and thin and shows only at the apex of the acetabulum, or may be entirely wanting.

12. The capsular ligament is thickened throughout, and may show an especial thickening just above the apex of the acetabulum, so as to form a retaining lower rim for the false acetabulum, and form an obstacle to reduction of the head.

13. Only the adductor muscles offer marked resistance to reduction of the deformity.

SUMMARY. Judging from the examination of these specimens the anatomical peculiarities in congenital dislocation of the hip are:

1. A dislocation of the head of the femur upward and slightly forward upon the surface of the ilium.

2. A shallow, triangular acetabulum, which faces more or less directly outward.

3. A diminution in size of the head of the femur.

4. A diminution of the angle between the neck and shaft to nearly a right angle.

5. An increase in the angle of femoral torsion.

6. A capsular ligament, in the form of an hour-glass or a simple sac, adherent to the surface of the ilium above, sometimes dilated about the acetabulum below, and constricted about the neck of the femur.

The obstacles to the reduction of the deformity are:

1. The peculiar attachment of the capsular ligament, which causes a shortening of ligamentous bands at various points, chiefly laterally and below.

2. Constriction of the middle of the capsule, so that it may be impossible to draw the head of the bone through the constriction.

3. Thickening of the capsule just above the apex of the acetabulum.

4. Adhesions between capsule and head of the femur.

5. Contraction of the adductor muscles.

6. An increase of femoral torsion so that when the head of the femur is placed in the normal acetabulum the knee looks inward.

Obstacles to retention of the head of the femur after complete reduction are:

1. A flattened or insufficient acetabulum, placed too obliquely.
2. An insufficient head.
3. An extremely short neck of the femur.
4. Obliteration of the cavity of the acetabulum by a mass of dense fibrous tissue.

From these specimens it is evident that under some circumstances the capsule is narrower than the head in the portion between that covering the head and that covering the acetabulum. In some cases, also, this narrowed portion of the capsule is too strong to be readily dilated, and it may be regarded as a displaced cotyloid ligament lying in front of the head instead of around the neck. Where this is the case it is impossible to dilate it, and the structure must be cut if a complete reduction is desired. If this division could be done with slight risk, it is manifest that it is better surgery to divide it than to rely on the uncertain and slower process of absorption by pressure. It is impossible to say in how many instances this condition of the capsule persists.

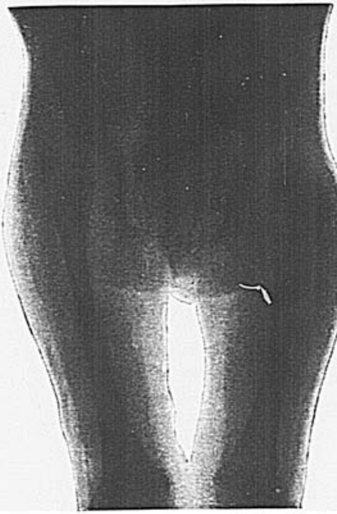
In other instances the acetabulum is placed at too slight an obliquity to hold (or has too little a projecting lip) the reduced head firmly. This would appear to be a rare condition, though it is indicated in the skiagraph. Where it is present either the curette must be used or the acetabulum deepened by continued pressure of the femur inward for a sufficiently long time as to make the position secure by promoting firm growth of the capsule holding the head of the femur in place.

Where there is an abnormality in the axis of the neck to such a degree as to occasion either inversion or eversion of the foot too great to secure a normal relation of the head with the socket, dislocation will recur unless the twist is avoided. This can be readily done by an osteotomy of the femur below the lesser trochanter. It is necessary, as Lorenz has shown, to place the head of the femur well in the acetabulum, and relapses will occur if this is not accomplished, or if it is not retained for a sufficient length of time for the adjustment of the soft parts.

It is also necessary for the pelvi-trochanteric muscles to have time to become shortened by adaptive shortening in order to keep the head of the femur well against the socket. The increased distance between the acetabulum and the femur and lack of close coaptation is seen in the skiagraph picture of a reduced case as well as the lack of a stray projecting lip of the acetabulum.

In forcible reduction a fold of the capsule lies between the head of the femur and the acetabulum, the relapse is liable to occur if the tissues are so firm as not to be penetrated by the pressure of the head thrust into the acetabulum. A relapse also occurs in case the head is not sufficiently under the shoulder of a projecting upper lip of the acetabulum. Where this anatomical variation exists it is necessary that the limb be left in an abducted position for some time, until the cartilaginous tissues become sufficiently firm to hold the head of the femur in place. It is also necessary, as Lorenz has shown, that the head be well thrust into the acetabulum. A relapse is liable to occur also from obliquity of the neck. Where the neck is so twisted that when the foot is held in a position usual in walking at right angles to the cross axis of the pelvis, relapse will take place, if, owing to the obliquity of the neck, the head is thrown either too far to the rear or too much in front to be contained within the cup of the acetabulum. Where this takes place an osteotomy is necessary, in order to correct the twist of the femur. This has been done in the case illustrated in Fig. 22. It is needless to say that if any of the soft tissues remain contracted to such an extent as to

FIG. 22.



Skiagraph of congenital dislocation reduced by open incision, with subsequent osteotomy to correct increased femoral torsion.

prevent the head from being placed well in the acetabulum a relapse is liable to occur.

Another cause of relapse may take place in case the pelvi-trochanteric muscles have been so far lengthened by the abnormal position as not to hold the head of the femur well into the socket after the reduction. Where this is the case the femur must be kept well fixed for several months in a position in which the muscles will have an opportunity to contract, or the attachments of the muscles should be cut down on and set well back on the insertion of the trochanter. This can be done if an open incision is tried.

Deformities of the shape of the head or in the acetabulum, which make a reduction impossible, are exceptional in young children. Where they occur a perfect result cannot be expected.

The development of the successful treatment of congenital dislocation of the hip will depend upon the accumulation of experience guided by thorough pathological knowledge. In treatment of this sort the skiagraph is of great value. It is, however, not of as great a value as it is desired, owing to the fact that the rays will penetrate the cartilage and leave a great deal to the imagination for interpretation. If the X-ray is perfected to the extent of enabling us.to see more perfectly the condition of the hip-joint before and after treatment, and at the different stages of treatment, it is reasonable to presume that greater certainty in the results can be obtained.

The permanency of the benefit to be obtained from the correction of congenital dislocation of the hip has been well demonstrated by cases where reduction has remained permanent after three or four years, but the subsequent growth of the limbs ten years or more after operation has not yet been demonstrated. That, however, the growth would be better and the use of the limbs greater if the head is in the socket than if it is out of the socket is probable if not certain. The difficulties in correction of congenital dislocation have been so fully discussed that further mention of this is not necessary in this paper, which is intended to emphasize the necessity of thoroughness in after-treatment to prevent relapse.